

Testimony of Gary C Hudson
Before the House Subcommittee on Space and Aeronautics
5 November 2003

Mr. Chairman, members of the subcommittee;

I have spent thirty-four years of my life promoting commercial space transportation, and intend – even in my current semi-retirement — to continue to speak my mind. Thank you for listening.

Today there is an argument raging in the emerging launch industry. How should piloted human space flight vehicles be regulated?

The origin of the debate goes back two decades. At that time, private rocketeers faced a number of Federal Agencies each who claimed they were in charge. These ranged from the FAA, which had the legitimate authority under the existing law, to the Department of State, which wanted to regulate rocket launches under the absurd notion that they were “exports.” The professed goal of the sponsors of the first Commercial Space Act was to put an end to this problem and provide a “one-stop-shop” for launch approvals. I supported that unreservedly.

But I lost the battle to limit the scope of the Act. Instead, a completely new entity was created: the Office of Commercial Space Transportation, as well as a completely new concept: “Federal launch licenses.” At the time, some of us complained that the new entity wasn’t needed, that the existing law was adequate with minor revisions, and that the new OCST would not be able to figure out what to do about piloted reusable rockets. Our concerns were brushed aside. They have now emerged as crucial to the future survival of an industry in crisis.

Some in this industry may be concerned that I stand in opposition to HR 3245. This is decidedly not so. I do support it and, with additions, wish to see it pass. I applaud those who have worked hard to bring it before this body. I will be happy to work with you to improve the wording of the Act to address certain issues. One of those issues is the perception of risk.

It is my duty to remind this committee that there has been no third party injury since the beginning of the Space Age in the Western world. During the past 20 years, we have spent tens of millions of taxpayer's dollars funding AST and before it, OCST. In the next decade we will spend over \$100 million more. Just for regulation! My question to our industry and this Congress is: have these funds made us safer than if we had retained our previous regulatory structure under previous Federal Aviation Regulations? I think the answer is unambiguously no.

AST has grown increasingly bureaucratic. Launch Licenses are now Major Federal Actions. In spite of my warnings and counsel of the past five years, we have now reached a crisis. Experimental flight-testing of suborbital passenger vehicles has begun. AST is not up to the challenge of this development. Therefore, I recommend the disestablishment of AST, and the elimination of the need for US persons to seek "launch licenses." In its place, I propose that we return to the pre-1984 law governed by Federal Aviation Regulations. This will be sufficient to protect the safety of third parties and to fulfill international obligations. Piloted rocket aircraft of a variety of types will then be regulated by the FAA under "experimental" type certificates. Several rocket aircraft already have been issued such certificates.

The strongest objection to such an approach comes from colleagues who wish to begin offering immediate passenger rides who fear the cost of FAA certification. I understand their position, and sympathize. And I believe that a barnstorming era for space transportation is desperately needed. But we can reach that result by other forthright action.

Current FAA rules generally prohibit revenue flying of experimental aircraft. I propose we simply change the rule. Congress can permit certain experimental aircraft defined as space vehicles to operate under a limited exemption for a period of time – 20 years. Coincidentally this is the same period from the Wright Brothers first flight to the establishment of the first Civil Aeronautics Authority in 1926. Some have asked how we protect the passengers on these flights? HR 3245 correctly supplies the solution by defining "spaceflight participants" as someone who would give their informed consent to fly.

Another issue is liability. In 1972 the US government unwisely assumed responsibility for worldwide third party liability from space launches by any US person. Fortunately, the letter of the treaty can be satisfied by requiring that individual launch operators obtain liability insurance. Indeed, this is a current AST requirement.

Interestingly, a similar system is in place for commercial launches in Russia. There are no launch licenses, no environmental impact statements, and no two-year process costing hundreds of thousands or millions of dollars. Provide your insurance certificate, submit proper notifications, and you are good to go. How is it that the bureaucrats of the former Soviet Empire can be more sensible than we?

Signing the first Commercial Space Act twenty years ago, President Ronald Reagan said we would “cut red tape to see blue sky.” Let us finally do as he wished.

Thank you.

Gary C Hudson
(gchudson@aol.com)

Commercial Space Act of 2003
Testimony of Gary C Hudson
Written Response to Question and Answers

Subcommittee Questions:

Should the government regulate commercial human space flight? If so, what should the public policy objectives (e.g., encouraging development of the industry, protecting third parties, protecting passengers, etc.) of that regulation be and should they be balanced?

This is an excellent question. The air travel industry experienced it's "barn storming" era and operated for over 20 years before the creation of the Civil Aeronautics Administration in 1926. Commercial human space flight needs a similar period of minimal regulation to reach its full potential. Promotion of the industry should be encouraged, and the best means to accomplish this will be a light regulatory hand. Regulation should be confined, for at least the next twenty years, to protecting third parties. Passengers need no protection in the near term, since no one can be imagined to be engaging in this experience who is not appraised of the risks. I favor having an "informed consent" requirement for these second parties.

Should the government offer indemnification for commercial human spaceflight, and if so, against what sorts of liability? How should any indemnification relate to existing policies and international treaties?

I do not believe that the government should provide any indemnification whatsoever to first or second parties (vehicle operators or passengers). I believe the government should require operators of commercial human space flight vehicles to obtain third party liability insurance with the US government as a named insured as is currently required. This is consistent with the requirements of international law, including the 1972 Liability Convention. I do not see why the commercial space industry requires indemnification to succeed when third party risks are virtually non-existent. In the past fifty years there have been no third party injuries or fatalities from space launches in the Western world. Ideally, I would like to see the US withdraw from the 1972 Liability Convention or renegotiate it to a regime more in keeping with the liability limits that were placed on international air travel operations by the Warsaw Convention. There is no rational reason why the actions of a US person should implead the US government in tort claims.

What changes would you recommend to H.R. 3245? In particular, do you support commercial human space flight being regulated by the AST? If not, where and in what manner would you propose to regulate commercial human space flight?

I recommend the following changes to H.R. 3245:

- 1) Clarification that vehicle operators, and not the government, are to set the medical and other standards by which they accept "spaceflight participants" into their programs;

- 2) Disestablishment of AST.
- 3) Direction to FAA to permit experimental spaceflight vehicles to be operated for profit, with the added requirement that third party liability insurance be provided by vehicle operators identifying the US government as a “named insured.”
- 4) Elimination of “launch licenses” in favor of reapplication of FAR 101, with appropriate minor changes, to conduct unmanned rocket launches.

I do not support commercial human spaceflight being regulated by AST. I recommend disestablishment of AST for the reasons cited in my testimony. I recommend that commercial human space flight be regulated within the FAA by AVR (Regulation and Certification Group) under the “type certification” environment used for all other aerospace vehicles.

Additional Frequently Asked Questions:

You favor elimination of AST. Isn’t that a radical solution?

I prefer to think that saving \$100 million+ over the next decade, by disestablishing AST now, is the far more rational solution. If third parties were really at seriously high risk from space launch activity, there would be a legitimate argument for AST’s continued existence. But the record shows that modern space launch of any type (orbital or suborbital, manned or unmanned) is essentially free from measurable risk to third parties.

It should also be noted that AST has 70 or 80 staff at any one time, who do nothing all day but study what new regulations they think might be desirable, process license applications or think up new requirements for industry. At the same time, the *entire* suborbital human space flight industry does not have as many engineers and technicians *actually building the vehicles!* Regulators actually outnumber the people doing the work; this would be considered a parody of regulatory behavior in almost any other area of human endeavor. For example, what if the FDA had as many regulators as there were physicians?

Who would be in charge of regulation if AST is disestablished?

The same organization that had regulatory responsibility for private rocket activities prior to the formation of OCST in 1984, the FAA via FAR 101.

Regarding Unmanned Rockets. Given that unmanned rockets have to be launched from specialized facilities established by Federal or State authorities, that are regulated at the local, county, state and national level by environmental rules, air traffic rules and many other health/safety laws and regulations, there is simply no need for an additional overarching level of bureaucracy to control launch facilities or rockets. These facilities establish detailed safety regulations to which all launch operators must adhere. AST is not needed to assure that launch operators of unmanned rockets abide by these rules and regulations, since the operator will not be allowed to fly if they fail to comply with range

rules. AST adds *no safety* to unmanned operations but *costs* launch operators hundreds of thousands to millions of dollars in added regulatory compliance each year.

Regarding Human Space Flight Vehicles. Piloted vehicles can be regulated as aircraft per the Federal Aviation Regulations. They should be allowed to operate from the same categories of airfield that more conventional experimental aircraft do; when fully certificated, they should be allowed to operate wherever certificated aircraft may, subject to noise and emission regulations.

AST says they will “tailor” launch licenses to permit experimental flights. Isn’t this a reasonable solution to the problem of experimental flight-testing?

No. When a research aircraft developer gets experimental type certification, the developer may fly as frequently as he wishes, when he wishes, and may make modifications to his aircraft during the test program without obtaining further certification approval from the FAA. By contrast, AST has not yet developed their “tailored” rules, but appears to want far more restrictions than those which are imposed on *any* experimental aircraft to date, even though the suborbital vehicles being proposed (or flying) have virtually no potential for third party harm. Even if they adopted the exact same rules as FAA/AVR, they would be an unnecessary and expensive redundancy. AVR can do the job, with no additional staff or funds, if the job is re-scoped away from being a “license” invoking the specter of a Major Federal Action.

You refer to “aircraft” but many piloted space launch concepts are not winged airplanes. How would these be regulated?

According to the legal definitions in the FARs, “aircraft” is *any* device that flies in or through the air. Since physically all space vehicles *must* fly through the air on their way to space, they are *already by definition* aircraft. The FARs regulate many types of aircraft that are not “fixed wing” such as rotorcraft, gliders and powered-lift vehicles as well as rockets. In fact, if the current AST approach followed the only type of aircraft not covered by the FARs would be piloted suborbital space launch vehicles. This makes no sense. One class of vehicle should not be taken completely outside of the FARs simply to justify the existence of an entity (AST) that is not needed in the first instance; an exemption should be made to allow that specific class of aircraft to be operated for profit within the FARs.

Isn’t certification very expensive?

That depends. Certification costs vary widely, and much nonsense is spoken about them. There are many levels of type certification. So called “standard type certification” is only one of them. It is true that the certification costs for a new Boeing commercial aircraft may be hundreds of millions of dollars. Smaller, four-place, general aviation aircraft are routinely certificated for much less. If this was not so, no new general aviation aircraft would be built. Yet new models are being introduced every year, ranging from trainers to light jets. The perceived impediment of “standard type certification” would be obviated in the near term (for the next 2 decades) if we adopt my suggestion to permit experimentally

type certificated space vehicles to be flown, with limitations, for profit. This is a “no cost” solution. Full standard type certification would not be mandated for 20 years.

When one considers the multiplicity of “plans,” documents, reviews, meetings, tests and acceptances now being required by AST to obtain a reusable launch vehicle license, the cost of “certification” vs. the cost of RLV “licensing” seems to have become comparable in both time and dollars. The ultimate difference is that RLV licensing is being done by an entity with no experience providing true certification expertise to the operator, while the FAA/AVR has certified thousands of different aircraft types. Furthermore, once an operator has a type certificate, the vehicle may be flown without any further notification or permissions (excepting a flight plan) while AST requires 60 day advance notification of every flight, and intrusive and burdensome inspections, reviews and further approvals to operate once a license has been granted.

Is there any example of experimental type certificated aircraft being operated for hire today?

Yes. The FAA now allows experimental type certificated aircraft to be rented to certified flight instructors, who may then use them to train student pilots. This is operation for hire and is a recent exemption to the rule. The rationale for letting student pilots pay to fly in an experimental aircraft is the same as I propose for “informed consent spaceflight participants;” that is, the student pilot, by virtue of his or her training, knows the risks and is able to make a judgment to accept or reject the risks. The suborbital or orbital spaceflight participant would be assumed to be capable of the same judgment. The spaceflight participant will not be walking up to a ticket window and buying a seat; it is widely expected that they will undergo instruction and orientation training by the firms offering the flights prior to being accepted to fly.

A “CLEAN SHEET” PERSPECTIVE ON PROMOTING AND REGULATING THE COMMERCIAL SPACE FLIGHT INDUSTRY

By

Gary C Hudson
October 28, 2003

For the purposes of this white paper, I will generally assume that the current space flight promotional and regulatory structures of the United States Government (USG) do not exist. While naïve, a thought experiment that allows for the possibility of a “do-over” positively serves to focus our attention on first principles rather than waste time and effort parsing existing rules and regulations.

I make one initial assumption: that it is in the interest of the Congress and the American people to foster a healthy, growing space flight industry. Like the history of its predecessor, the air travel industry, the benefits seem obvious: the more frequently we fly and the more varieties of machines we fly, the lower the cost per flight. This is the way we will learn about making space flight safe and reliable and the result will be increased economic potential for the Nation. When we fly both frequently and safely, we begin to implement the dreams of a true commercial space frontier that generates wealth and helps provide for our future prosperity and security.

However, the desire to fulfill international treaty obligations and to protect public safety has led us to a cul-de-sac in the road to a hopeful future. We have stumbled in our ability to promote the space flight industry, imposing an unclear, overly bureaucratic regulatory environment that is stifling innovation, progress and commerce. We need to rethink our approach from first principles; that is the purpose of this white paper.

The key question is how do we get from our present condition (no routine, affordable space flight) to a robust, innovative industry that creates new technologies and new commercial opportunities for our citizens? I believe the answer is to emulate the model that has given the United States – and with it the World – safe and cheap air travel. The process that has been used for the past one hundred years to bring us to the era of modern air travel can be profitably analyzed and adapted to provide the same boon for commercial space flight.

First I will discuss promotion of the industry, since the matter can be dealt with fairly expeditiously and because there is little debate about the desirability of some degree of industry promotion.

Industry Promotion. If we ask the “first principles” question, “why should the USG promote commercial space flight?” the simplest answer is to help US companies employ, grow and generate revenue. If we assume that no entity currently exists to promote commercial space flight, how would the nascent commercial space flight industry best be served? Responsibility for promotion of commercial activities resides principally within the USG Department of Commerce. Such promotion is helpful only to the extent that it produces substantive results assisting US companies in identifying opportunities and penetrating new markets. While there is

tremendous potential to promote the growth of commercial space markets, including space tourism, the bulk of the current market for space launch services is in sales to the USG. The establishment of a DOC Office of Commercial Space (OCS) chartered to assist commercial space enterprises in doing business with other elements of the USG would provide the first step. We could consider this a “one-stop-shop” to assist companies in identifying USG business opportunities such as bidding on launches or spacecraft that serve USG needs.

To be clear, I am thinking of this office as an advocate for the companies rather than as a contracting office. For example, NASA is obligated by statute to purchase commercial space transportation services if offered by private entities rather than to develop its own systems. In the absence of promotion and awareness, NASA routinely flouts this law. A Commerce Department Office of Commercial Space should be tasked by the Congress to insure that NASA and other USG agencies meet their statutory obligations. This will open opportunities for existing and emerging companies to provide commercial space transportation services as the Congress envisioned. Since emerging space flight companies do not have the resources to challenge taxpayer-financed legal departments at organizations such as NASA, the only fair way to exert real leverage on behalf of the emerging industry is to use government lawyers to deal with government lawyers. Hopefully just the threat of such a challenge would be enough to ensure it never reaches the stage of legal action, and most matters would be addressed at the level of interagency policy board interactions.

DOC OCS would also administer any incentive programs that the Congress might establish in the future. For example, loan guarantees and insurance indemnifications have been proposed or passed previously. Without addressing the merits of either, I would assign the DOC OCS the responsibility for administering such programs. Likewise, should the Congress ever decide to establish prizes or other incentive programs of any kind, DOC OCS would be the point of interface and administration.

Industry Regulation. If we then approach the question of regulation from first principles we have to ask the question: “why regulate?” After all, Jefferson was famous for teaching “that government which is best, governs least.” The air travel industry experienced its “barn storming” era and operated for over 20 years before the creation of the Civil Aeronautics Administration in 1926.

It is believed by some that “licensing” by the USG of private actions in space (including space flight) is required to meet our obligations under the Outer Space Treaty. From first principles, one might question the desirability of continuing to adhere to an archaic and restrictive international agreement promulgated principally by diplomats of the former Soviet Union at the height of the Cold War. Their goal was to limit the ability of Western countries with free societies from maximally exploiting the benefits of private space flight. Asking for repeal of the Outer Space Treaty seems beyond the charter of this white paper, but we can fulfill the letter of the Treaty through a very mild regulatory regime. So, in the final analysis, the Outer Space Treaty alone is no bar to a sensible and adequate regulatory environment. I argue that a generic “approval” process, which does not rise to the level of a major or significant Federal action, can provide the international fig leaf necessary for treaty compliance. Addition of an insurance

requirement with the USG as a “named insured” can solve the liability issue created by the Treaty.

Past USG legislation refers to three specific elements that warrant establishment of regulatory oversight of space flight operators. First, and most obvious to virtually all observers is public safety. In addition, “national security” and “foreign policy interests” are also called out as justification. I will deal with public safety momentarily, but first it is helpful to address the other two issues, since they can be linked.

Much bad law is promulgated in the name of “national security.” The best national security comes from a technologically vibrant and healthy growing economy. We can best defend ourselves when we are both rich enough to pay for the best defense, and when we can employ the most capable technology in our defense. Often time we damage our security and our international competitiveness in the name of “national security” and “foreign policy interests”. The matter of export controls comes to mind. While this is not the forum for that particular debate, it needs to be recalled that the European Ariane program exists almost exclusively because, for “national security and foreign policy” reasons thirty years ago we elected to reject a French application to launch a *Symphonie* dual use communication satellite on an American booster. This decision led directly to the creation of the *Ariane* and its capture of half of the world launch market for two decades. Rejection did not make us any more secure than we would have been had we made a decision that would have prevented a united Europe from funding a highly competitive and subsidized commercial launcher.¹ And it hurt us badly from a commercial launch business viewpoint.

The need to act with regard to rockets and public safety is a far less controversial issue. One hundred years of air travel has resulted in a busy, crowded airspace that requires coordinated efforts to maintain safety. Few would argue that some form of regulatory oversight is reasonable. At the same time, few voices currently call for any but third-party protection. (First parties are the vehicle operators. Second parties are passengers or “spaceflight participants.” Third parties are people with no relationship to the activity. Once the industry is mature, some degree of protection for second parties comparable to that in operation for civilian transport aircraft will be appropriate, but that time is decades in the future.)

Thinking from “first principles,” let us bound the public safety problem by asking the question “why do we need the USG to regulate third party protection for space flights?” What is the risk to the public if all forms space flight were completely unregulated by the USG? We face many of our current problems because of our inability to understand risk, and our perception is that it is high. Lack of a technical understanding of how space vehicles operate and how much damage they can cause seems at the root of this problem. The problem is further exacerbated by the way we visualize failure. Specifically, if one sees the explosion of a launcher, that explosion fills the

¹ In a perfect world, I would not unduly restrict the overseas transfer of finished space launch components or systems (these being different than the technology or know-how to fabricate same) to countries who have shown they are not a near or long-term threat to the US. (How to make this distinction? As historians note, no liberal democracy has ever gone to war against another. Let the Department of State certify acceptable countries and the matter is solved.)

screen of our television, simply because the cameraman is doing his job. This drama hides the truth. Insurance statistics, as evidenced by market rates of third party liability insurance, tell the real truth. No third party is injured in these failures! No third party was injured by the breakup of the Columbia, even though 200,000 pounds of debris fell over several states. So low was the risk that humans would be harmed, that only about 40% of the orbiter was even recovered; 60% burned up or fell and will never be found. And this is not merely the luck of the draw. Analysis of the impact to human life if the breakup had occurred one orbit later, placing it above Dallas-Fort Worth, has shown essentially identical results.

A number of constraints are present already on any space flight. For the vast majority of suborbital or orbital flights, space flight is an expensive proposition. The cheapest space flights are ones that do not go to orbit. In this case, a few efforts are currently underway to build small X-prize-class suborbital launchers. Yet the cheapest of these cost a few million to a few tens of millions of dollars, not a sum to be spent by irresponsible individuals or organizations. There are airspace restrictions imposed by the FARs. One can't simply build a rocket in the suburbs and launch from one's driveway. Another constraint is insurance. Suppliers often choose not sell propellant, avionics and other materials to builders who appear to lack commonsense or minimal third party liability insurance. Even today, some X-prize contenders can't purchase the propellants they require because the manufacturers are afraid of liability, not from third parties, but from the flight crew or operator's employees who might sue if injured in ground or flight test. These and similar constraints on wild or irresponsible behavior are acting totally in the absence of any burdensome USG regulation.

Under FAR 101, provision existed for unmanned rocket flight approval by local FAA offices with only a fraction of current AST oversight requirements. In fact, we know this approach works, since many quite large amateur rockets, not to mention the US's first commercial rocket in 1981 and another in 1982, operated in a regulatory environment of exactly this nature. No injuries to any third parties resulted from this lightly regulated activity prior to the creation of Office of Commercial Space Transportation in 1984.

However, assuming that meeting our obligations under the Outer Space Treaty demands some further USG oversight, an option might be for the USG to establish minimum third party insurance requirements in order to obtain "approval" to operate space vehicles. Establishing this standard is straightforward – such calculation is a minor part of current licensing. The amounts set for "maximum probable loss" have so far been eminently reasonable, usually well below \$100 million. This amount is readily available on the world market. I myself bought a comparable amount of third party liability insurance for less than \$100,000 in 1981. I bought this insurance, not because of a USG mandate, but rather because our customer asked us to do so. (Note that I am not talking about "launch insurance" or that type of insurance that protects a spacecraft owner from launch failure and pays a claim if the launch vehicle fails to deliver the spacecraft to the desired orbit. There is a limited pool for such insurance, and premiums are very much higher than for third party liability insurance.) These premiums reflect the market knowledge that there has never been a third party claim of any magnitude in the history of Western space launch programs.

Once a maximum probable loss calculation was performed by the designated regulatory entity, I would recommend that it be reviewed and approved or at least concurred with by the aforementioned DOC OCS. This safeguard would prevent unreasonable regulators from subverting the process. I would also recommend that the entity setting the insurance standard be required to make the determination in writing within 30 days of a request for a determination, that the term of the determination be for a period of at least five years with a review at the one year mark to allow for the lowering of the requirement if the record of the vehicle or system so warrants, and that a appeals process including the DOC OCS be included in the law. Finally, a Congressionally set upper bound on the determination is needed, perhaps to be set at \$500 million. However, no taxpayer-funded indemnity should be provided for amounts that exceed the Congressional upper limit. To do otherwise simply removes the incentives of third party plaintiff to settle any claims for reasonable amounts.

It is tempting to stop here and not explore more involved regulatory oversight of the type we currently see. But if we desire more oversight, at a minimum the scope and force of the regulation should be limited in keeping with the real, and not the imagined risk, posed by commercial space vehicles. It should be comparable to regulations imposed on equivalent vehicles in a similar industry.

Every year, thousands of new experimental aircraft are licensed by the FAA via a one-page “experimental” type certification application, in addition to a one-hour or shorter inspection often times conducted by an FAA Designated Airworthiness Examiner who might not even be a government employee. Many of these aircraft crash each year. Usually pilots and passengers are killed and occasionally third parties as well. Experimental type certification applies equally to small home-builts, converted war-birds as big as a B-17, exotic aircraft built for research purposes and even jumbo jets prior to completing “standard” type certification that allow them to be sold and operated in passenger revenue service.

It is easy to show that the economic promise of the commercial space industry exceeds that of amateur built aircraft whose owners currently use the experimental type certification process. (I am not denigrating the social or economic value of these thousands of amateur-built aircraft, but simply making the point that the total dollars currently generated by commercial space launch already exceeds the market size of the home-builts by a substantial fraction. Once a growing space flight industry expands, that disparity will become even more obvious.) Since a third party casualty or fatality is just as hurt or dead if injured or killed by a *Lancair-IV* crash as they would be if they were the victim of an out of control *SpaceShipOne*, there is a gross disparity in the law if we treat space flight vehicles differently from experimental aircraft. Our failure is in our perception of an accident event, not in the results.

It is no challenge to say that space flight vehicles fail more often. Perhaps that is true; the casualty numbers suggest it is also irrelevant. Injured is injured, dead is dead. One might contend that space launch vehicles make bigger smoking holes in the ground, and thus have a higher potentiality for damage than a home-built. But this is also misleading. It is true that most (but by no means all) space flight vehicles carry flammable fuel (usually the same as commercial jets use) and oxidizers (such as the liquid oxygen that is stored in large tanks outside of every hospital in this country) and the unplanned mixing and combustion (or rarely detonation) of these

propellants can be spectacular. Yet it should be remembered that most explosions of space flight systems are planned; they are the result of the system working, and the termination of flight in this manner prevents unmanned rockets from going where they are not wanted. It is quite rare that a rocket blows up on its own due to a systems failure; even so it is not unusual for such a problem to occur even with certificated passenger airliners, i.e., TWA 800 that suffered a fuel tank explosion, or several other similar accidents. The mere fact that rockets can produce larger explosions than some experimental aircraft does not change the fact that at any conceivable launch rate over the next few decades, with any imaginable failure rate, they can *never* exceed the currently acceptable casualty losses of the existing experimental aviation community.

The space launch industry labors under another burden not faced by experimental aircraft operators. When a developer wishes to design and build a new aircraft, no matter how big, fast or dangerous it may be, there is no requirement for any involvement of the National Environmental Protection Act. By creating a licensing regime specific to launch vehicles (as distinct from the approval process for aerospace vehicles controlled under the FARs), the USG has introduced the wild card of “Major Federal Action” now interpreted as requiring an environmental review, assessment or impact statement for each launch license. For the few dozen licenses issued to date, the results of these reviews have always been “FONSI” or Finding of No Significant Impact. The Congress can mandate that enough is enough and that no further review will be required for each license, or they can dispense with licensing altogether and simply designate launch systems as aerospace vehicles already exempt from NEPA under the FARs, not requiring such review. Millions of dollars continue to be wasted conducting these time-consuming reviews that have no measurable benefits. (The FAR already cover launch systems of all types, by definitions long-standing. An aircraft, according to the FAR, is a device that flies through the air under power. Powerplant is irrelevant. Finally, the FARs also define what a rocket is. These definitions date from 1963.) So where do we go from here?

The establishment of OCAST was promoted on the grounds that it would streamline a chaotic approval process. At the time, some alleged that as many as nineteen Federal agencies had regulatory authority over launchers. While that number never proved to be anything but a sound bite, and flying in the face of approvals that had been granted to previous large commercial rockets a few years earlier, it is true that some USG entities did propose rather tortured interpretations of their regulatory authority. The most notorious was the Department of State, which proposed to regulate launches under the export control provisions of ITAR. It is necessary to make certain that these spurious claims do not resurface, and it may be that legislation will be needed to further clarify the situation. The details are beyond my scope for the moment, but will deserve near-term attention when and if any of the ideas in this memo are implemented.

My recommendation is to disestablish FAA/AST and to let the FAA local FSDOs once again control unmanned rocket flight under FAR 101 as was done prior to the creation of OCAST in 1984. Insertion of a maximum probable loss calculation and third party insurance requirement into FAR 101 would be trivial. There would be no measurable impact on the safety of the public, but we would save \$11 million per year now spent on AST or more than \$100 million in the next decade alone.

But, what about piloted reusable space vehicles that carry passengers? They can also be handled quite simply. The chief objection that many have had to disestablishing FAA/AST and giving all its functions to FAA/AVR is that experimental aircraft cannot be operated for hire and that full standard type certification is too expensive for new operators. Given that the Congress can direct the FAA to change *any* provision of the FARs, a simple solution would be to provide permission for any experimental aircraft to be operated for hire, provided the passenger is fully informed of the risks, the aircraft is not operated as a scheduled transportation service under part 121 of the FARs² and the maximum probable loss calculation for third party liability insurance is applied. *This approach eliminates the claim that under AVR new operators would not be able to achieve the early revenues needed to attract investors and fund vehicle improvements.* The industry can be allowed to operate this way for some designated number of years – the barnstormers era – and then evolve an appropriate regulatory environment as experience is gained and the industry matures. Based on our experience with the development of the air travel industry, I suggest a period of twenty years until this provision sunsets.

Different provisions for piloted and unpiloted vehicles should be handled in the same way that FAA currently handles UAVs and piloted aircraft. Once deemed operational, vehicles will be flown – not on individual “launch licenses” – but instead after the filing of a flight plan in the same way an aircraft operator files for IFR operation. This is also how the FAA intends for UAVs to be integrated into the National Airspace System.

In this way the barnstorming phase of the commercial space industry can be nurtured, with demonstrably no new risk to the public, while providing an easy transition from experimental operations to early revenue service for “informed consent spaceflight participants.” Ultimately the industry would be fully integrated into the successful air transport enterprise that has provided the benefits of air travel to all Americans.

In the next few decades we would be able to amend that phrase to “the benefits of air and space travel.”

² If the FAA/AVR objects to this provision, they can be reminded that they are currently letting owners of experimental aircraft hire out experimental aircraft to flight instructors who then use them for pilot training. A suborbital or even orbital “spaceflight participant” can easily assume equivalent risk as a student pilot. A suitably controlling definition might also be developed that doesn’t permit experimental aerospacecraft to be flown for hire unless they are designed to operate over >50 Km altitude, to insure that only space vehicles benefit from this provision.

Implementation

Specific steps that should be taken to implement the philosophy espoused by this memo are:

- 1) Disestablish the current AST organization. End the practice of launch licensing.
- 2) Confirm that unmanned rockets fall under the purview of the FAR 101 and that piloted rockets of all types fall under the FARs for experimental certification.
- 3) Confirm that to operate any unmanned rocket or piloted rocket, an operator need only obtain permission from the FAA per either FAR 101 for unmanned systems or applicable FARs for piloted vehicles.
- 4) Establish that experimental aerospace vehicles can be operated for hire with limitations to focus this provision on human spaceflight if deemed necessary.
- 5) Confirm that launch, spaceflight, operation to or on other celestial bodies and reentry are not exports for the purposes of export control regulations. Further confirm that no other permits, licenses or approvals are required from the Federal government to operate aerospace vehicles.
- 6) Establish an advocacy office with DOC to promote and represent the industry especially within the Federal government.

Biography of Gary C Hudson

Mr. Hudson, 53, was a founder and Chairman of the Board of Directors of Rotary Rocket Company, and is a founding principal of HMX, Inc, an aerospace consulting and engineering firm. He is also founder and Operating Manager of AirLaunch LLC, a startup currently working on a military launch system for the Defense Applications Research Agency (DARPA).



Mr. Hudson has worked in the field of commercial space for over 34 years with an emphasis on development of innovative low-cost systems. In 1981, he built the first large private launch vehicle developed in the U.S. He is also the designer of the *Phoenix* VTOL/SSTO family of launch vehicles which led to the DC-X Delta Clipper project. He has participated in many launch vehicle projects including support for both General Dynamics and Boeing Aerospace Corporation during the SDIO program. He has published many

papers on space vehicles and systems and has authored several studies on low cost propulsion systems. At Rotary he managed the successful *Roton* ATV program, the only piloted reusable launch vehicle demonstrator to have flown since the Space Shuttle *Enterprise*.

In 1994 he co-founded HMX, which designs and develops innovative aerospace propulsion systems. In 1995 HMX developed a rocket engine propulsion system for Kistler Aerospace Corporation. HMX also provided early propulsion support to Scaled Composites for the *SpaceShipOne* project, participated in the NASA Alternate Access to Space concept study contract in 2000, and participated in the Phase I Concept definition for the DARPA RASCAL project. HMX also developed the DARPA MIPCC Test Bed, a sophisticated test facility located at Mojave, CA used to qualify the Mach 4 jet engines used in the RASCAL first stage.

In 1982 he co-founded Pacific American Launch Systems, Inc. where he was directly responsible the design and development of the *Liberty*, a small expendable launch vehicle using an innovative pintle rocket engine, which underwent prototype engine testing for the US Army Strategic Defense Command on behalf of SDIO at Edwards Air Force Base, California. During this period he also served as a consultant to the United States Air Force's "Project Forecast II." He is a former Board Member of the Space Transportation Association, a founder of the STA Space Tourism Division, a member of the Board of Advisors of the Space Frontier Foundation and has presented testimony before the U.S. Congress on several occasions.

Mr. Hudson has conducted seminars for the US Naval Postgraduate School, and the Institute for Space and Astronautical Sciences of Tokyo University and taught graduate-level launch vehicle design at Stanford University. He is a Fellow of the British Interplanetary Society and a Senior Member of the American Institute of Astronautics and Aeronautics. In January 1994 he received the "Laurel" award from *Aviation Week & Space Technology* "for the vision, drive and competence that have pushed [reusable launch vehicles] to the front of the U.S. launcher agenda."